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SOME TRACE ELEMENTS IN CANCER PATIENTS

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## FOREWORD

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## SOME TRACE ELEMENTS IN CANCER PATIENTS

- USSR -

[Following is a translation of an article by I. S. Gul'ko in the Russian-language periodical Zdravookhraneniye Belorussii (Public Health in Belorussia), Minsk, Vol. VI, No. 4, April 1960, pages 20-23.]

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One of the most important ways to discern the causes of the origin and development of cancer and for working out methods for its diagnosis and treatment is the quantitative and qualitative study of the chemical composition and metabolism both of the cancer itself and the entire body of the patient.

Despite the use of all modern research methods, the study of the chemical and physiological properties of proteins and nucleic acids in a tumor has not revealed any differences in their structure as compared with the proteins and nucleic acids in normal tissues. In recent years the use of tagged compounds has established the identity of the mechanisms of the formation and decomposition of proteins and nucleic acids in both tumor and normal tissues. No substantial differences have been found in studying the different enzymatic transformations of the amino acids -- deamination, transamination and the formation of hormones, vitamins, pigments, etc., from the amino acids. Differences exist only in the intensity of these processes which is determined by the different activities of the enzyme systems.

As a result of a change in the enzymatic activity of tumors there take place changes in the corresponding protein fractions, nucleic acids and other ingredients.

Among the substances which effect the enzymatic processes, the trace elements deserve particular attention. They have a favorable effect on the body when their assimilation corresponds to physiological requirements. When large doses of trace elements are assimilated they may have a pathological effect. In works by P. Horn, Burne and others, L. Teleky, C. H. Grogan and others we have indications of the high incidence of cancer, particularly of the respiratory tract, in workers subject to prolonged exposure to chromium, nickel, cobalt and their compounds. A number of experimental works have also been published by Schinz and others, Hueper, M. B. Hoagland, J. A. Thomas and

others, J. C. Heath, S. Hatem, which show that in laboratory animals arsenic, berillium, chromium, cobalt, nickel and certain of their compounds may induce the formation of a malignant tumor.

But not all the trace elements have the same effect. For instance, attempts to cause a malignant tumor with manganese or cadmium were unsuccessful (J. C. Paterson). J. Baló and others have indicated that manganese malate inhibits the growth of certain experimental tumors, exhibiting a tendency to alter metabolism in the tumor from anaerobic to aerobic.

The aim of this study was to detect the amount of certain trace elements in tumors, blood and organs of cancer patients as compared to the normal state.

For a control we used data which we had obtained from examining the blood of 16 first-time donors and the organs of 10 healthy persons who had died a sudden violent death.

116 cancer patients were examined. The distribution of the patients by tumor location, age and sex is represented in Table 1.

TABLE 1

Location of cancer	No. of patients examined	Men	Women	Age		
				to 29	30-39	40-49
Cancer	60	33	27	1	6	18
Lungs	16	11	5	1	3	1
Breast	18	1	17	1	7	4
Rectum	13	7	6	1	2	3
Other organs	9	5	4	-	2	2
Total	116	57	59	4	20	28

TABLE 1 (continued)

Location of cancer	Age		
	50-59	60-69	70-79
Cancer	24	10	1
Lungs	5	5	1
Breast	5	1	-
Rectum	4	3	-
Other organs	2	3	-
Total	40	22	2

TABLE 2  
TRACE ELEMENT CONTENT OF THE BLOOD IN HEALTHY AND CANCER PATIENTS  
(MICROGRAMS PER 100 MILLILITERS)

Spectrographic				Colorimetric						
	No. examined	Zinc in whole blood	Copper in whole blood	Manganese in whole blood	No. examined	Zinc in serum	No. examined	Cobalt in whole blood	No. examined	Nickel in whole blood
In normal health	Average 16	465-1090	69-144	7.8-20	16	100-175	16	5-7.6	16	6.8-18
	Fluctuation	820 $\pm$ 148	108.6 $\pm$ 12.5	12 $\pm$ 3.6		134 $\pm$ 20.4		6.2 $\pm$ 0.55		11.1 $\pm$ 2.8
In cancer:										
At admittance	Average 96	336-1300	56.8-230	5.2-34	91	48.2-220	63	4.3-13.4	47	7.2-22
	Fluctuation	732.2 $\pm$ 284	136 $\pm$ 40	14.0 $\pm$ 5.45		98.9 $\pm$ 34.8		7.5 $\pm$ 2.23		14.0 $\pm$ 3.7
At discharge after surgery	Average 45	358-1200	56-273	6.76-25.7	41	46-140	28	4.72-9.8	21	8.18.33[sic]
	Fluctuation	632 $\pm$ 197	143.5 $\pm$ 43.2	14.23 $\pm$ 4.46		80.0 $\pm$ 20.8		7.47 $\pm$ 1.38		14.45 $\pm$ 2.94

TABLE 3  
TRACE ELEMENT CONTENT OF CANCERS OF THE COLONS  
(IN MICROGRAMS PER 100 GRAMS OF FRESH TISSUE)

	No. examined				No. examined				No. examined	
	Zinc	Copper	Manganese	Cadmium	Cobalt	Nickel				
Lungs (normal)	Aver. 1280-3920 fluc. 2105+ 680	87-270	11.0-30.8	Trace-22	10	4.5-8.7	10	8.2-30		
Lung cancer	Aver. 1200-2110	153+49.6	22[?]6.1	18+5.2	7	6.2+1.16	5	15.1+5.45		
	fluc. 1671+ 331	162-408	11.2-28	10-30		4.5-15		8.3-32		
	Aver. 1490-3000	296.5+77.4	19.66+5.9	18.99+5.5	2	8.9	1	21.2		
Metastatic	fluc. 2203	173-330	10.7-29	15.0-23.0		8.2-12		16		
Stomach (normal)	Aver. 2240-5000 fluc. 3310+ 332	247.3	22.2	19.3	10	10.1	10	12-24.2		
Stomach cancer	Aver. 1758-4300	138-325	10.7-42	Trace-16	15	3.5-8.0	13	18.1+3.28		
	fluc. 3044.7+615	236+55.6	24.7+8.3	8+4.8		5.2+1.26		16-32.6		
	Aver. 1780-2200	145-590	14.8-41	Trace-21.7	2	5-16	4	22+4.9		
Rectum	fluc. 2020	277.36+71.5	28.6+6.95	9.49+4.2		8.84+2.8		33-60		
(of patients)	Aver. 2680-3000	100-423	30-72	Trace-19	2	4.4-5.0	4	44.0		
Rectal cancer	fluc. 2562	248	40.95	5		4.7	4	35.0-72		
Breast cancer	Aver. 1930-3392	350-430	26.0-40.0	Trace-20	2	7.0	2	46.2		
	fluc. 2666+ 439	377.5	32.8	7.6				19-41		
	Aver. 6560-11150	200.2-420	18.2-40	Trace-22	3	8.9-15.0	2	30		
Liver (normal)	fluc. 8000+1380	281+61	30+6.4	10.58+5.2	10	12.5	10	7-19		
Metastasis to liver	Aver. 2000-3700	495-1070	82-136	14.6-69.5	4	8.1-24	3	10.8+3.12		
	fluc. 2853	656+140.5	101+17.2	52.1+13		16+4.4		22-53		
	Aver. 1415-3000	116-478	23.8-32.2	16-42		7.2-15		34.3		
Metastasis to lymph nodes	fluc. 2334	266	28.97	27.74		11				
	Aver. 138-291	221.7	22.4-37.4	17-23	-	-	1	12		
	fluc. 221.7	28.3		19.5						

Zinc, copper, manganese and cadmium were determined by emission spectral analysis; nickel, cobalt and zinc in serum and organs were determined by the colorimetric method. Zinc in the organs was determined by both methods.

A statistical interpretation of the data obtained as presented in Table 2 revealed a substantial increase in the whole blood of cancer patients of the amount of copper, cobalt, nickel and a substantial reduction in the amount of zinc in the blood serum (in all these cases the observable difference was 3 times greater than the average error). It revealed a correlation between the amount of copper, manganese and cobalt in the whole blood of cancer patients and the degree of anemia: as the anemia increases the amount of these trace elements in the blood increases.

The amount of these elements in the tumor tissue (primary and metastatic) and in healthy organs is presented in Table 3.

As we see from the table all primary tumors contain more copper, cobalt and nickel than the corresponding healthy tissues. It was also discovered that a primary cancer and its metastases to the liver, lungs and lymph nodes have an almost identical concentration of the trace elements being studied.

An analysis of the data obtained showed that the trace element content varies not only in a tumor but in the blood and organs of cancer patients. These data confirm the tenet that cancer is not a local process but a disease of the entire organism.

We assume that the change in the trace element content of tissues and organs depends on the amount of substances in them which are capable of binding and inhibiting these trace elements. The identical amount of trace elements in primary cancers and their metastases confirms the common nature of their morphology and metabolism.

In conclusion let us point out that in all cancer patients, regardless of the primary location of the cancer, we found almost identical changes in the amount of these trace elements in the blood and organs.

## CONCLUSIONS

1. Cancer as a disease is regularly accompanied by a quantitative disturbance in the normal amount of trace elements (Zn, Cu, Mn and Co) in the body of patients, regardless of the location of the primary affection.

2. In the whole blood of cancer patients:

- a) the Zn, Cu, Mn, Cd, Co and Ni content does not depend substantially on sex, age or clinical stage of the disease;
- b) the average Zn content dropped, Cu, Co and Ni increased substantially and Mn has a tendency toward an increase;
- c) with a decrease in the hemoglobin content of the blood there is an increase in the Cu, Mn and Co content.